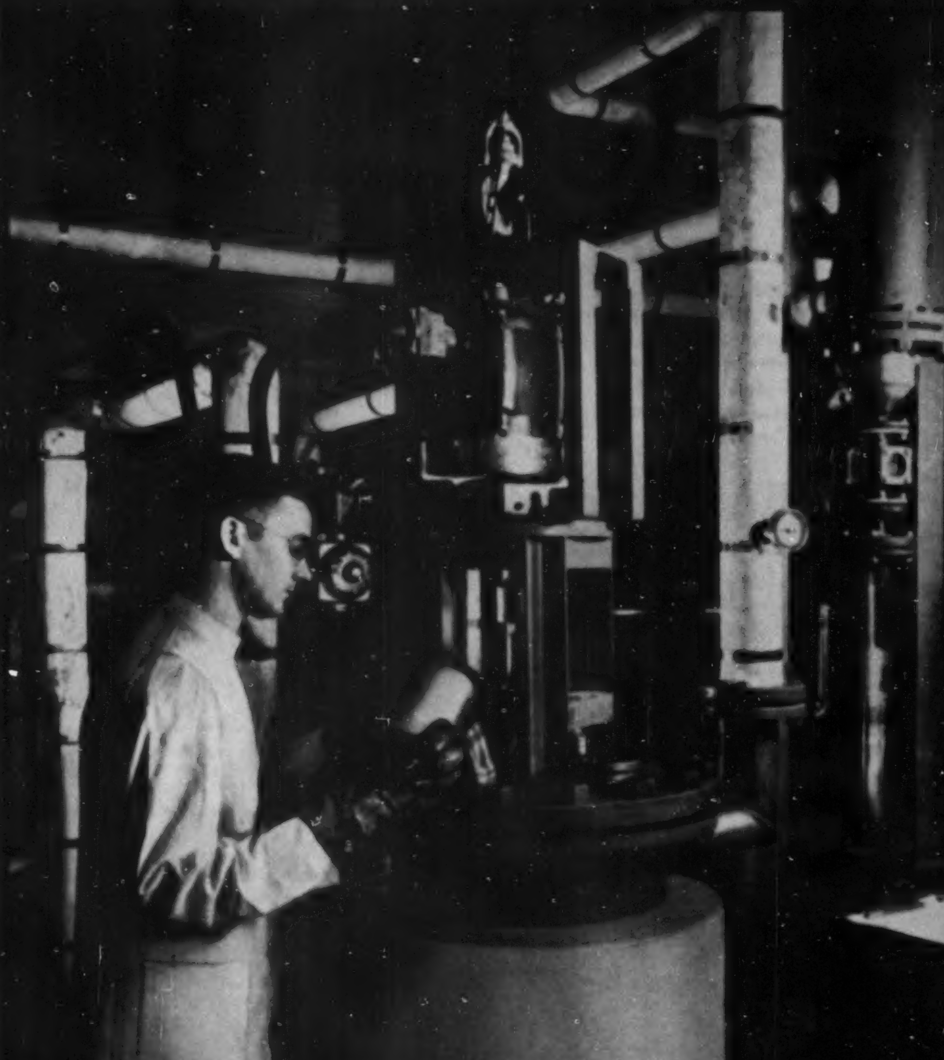
The Spokesman



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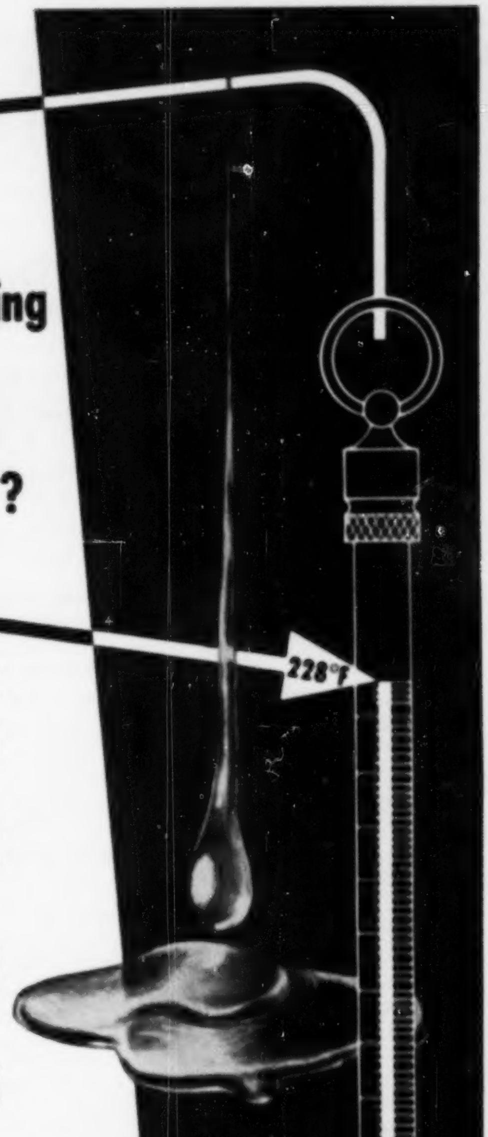

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The INSTITUTE SPOKESMAN

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ABOUT THE COVER

Pictured is one of several pilot scale reaction kettles used in the laboratories of the Witco Chemical Company.

This stainless steel reactor is equipped with pressure cover, explosion proof agitator, Dowtherm heating jacket, overhead condensing system, and other auxiliaries. It makes possible the accurate control and study of reactions accompanying the formation of alkali and heavy metal soaps.

Grease makers are well aware of the challenging nature of the soap making reaction. While quite simple from a chemical standpoint, it is most complicated from the physical structure aspect. Given the same raw materials, properties of the finished products can be varied over a wide range depending upon conditions existing at the instant of soap formation and upon its subsequent treatment. Soaps made by a direct fusion reaction of alkali and fat (or fatty acid) have a semi-fluid or plastic consistency and are generally brought to final form in this one reactor.

Precipitated soaps, on the other hand, require several additional handlings, and pilot facilities are available to carry out filtration, washing, drying, and grinding steps similar to those employed on a large plant scale.

Such pilot facilities are, of course, invaluable for checking results of laboratory bench investigations and also for determining operational procedures to be used in production. Further, they constitute an excellent customer service and sales development aid. Fifty to one hundred and fifty-pound lots can be prepared, tested in grease manufacture (facilities for making this determination are also available), and then submitted for field evaluation.

President's page

by Arthur J. Daniel, President, N.L.G.I.

FOR WANT OF A FAN BELT

You probably saw the article in the local newspaper . . . the one about the three Sherman Tanks that sat on the railroad siding in Chinju, Korea, waiting for fan belts. SOMEONE had shipped the tanks without these apparently "unimportant" parts . . . SOMEONE sent a rush, air shipment of fan belts that were too small to use . . . SOMEONE sent a second emergency shipment which turned out to be pistols, instead of the urgently needed fan belts. The lack of these parts prevented the use of these tanks and, as a result, the battle for Chinju was lost.

SOMEONE had fallen down on a job that hadn't seemed "important" at the time. That SOMEONE was cursed by a bedraggled group of battle-weary men, who spiked the guns and blew up the tanks before leaving their dead and dying behind in the retreat.

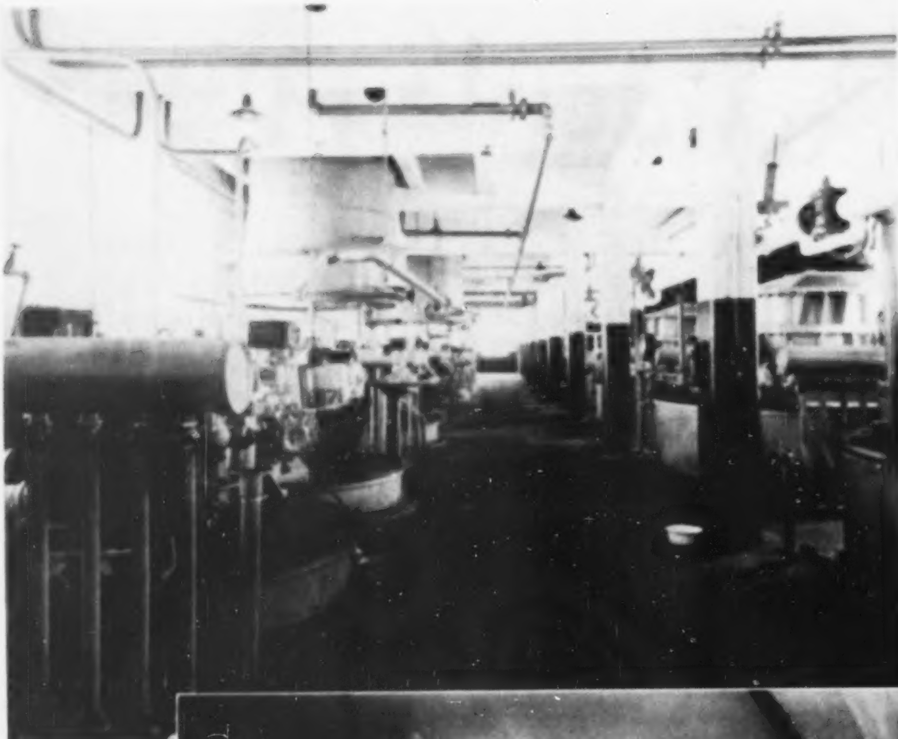
It might have been the lack of lubricating grease that prevented these tanks from fighting. It could well have been a burned-out bearing that immobilized this equipment, upon which men's lives were dependent. The SOMEONES who held the "unimportant" jobs could have been in the plants or offices within our industry.

When the lives of men and nations are at stake, there is no division between "important" and "unimportant" jobs. Some men must carry arms; others must produce the weapons and supplies— each is equally important. War makes no allowance for "good intentions", and an error in an "unimportant" task, thousands of miles from the scene of fighting, may cost the lives of men and determine the outcome of battles.

No one can doubt that ours is an essential industry. The products we manufacture and the services we perform are vital to our nation's existence. The machines that work the farms to produce our food, the machines that hum in our vast network of factories to produce our civilian and military needs, and the machines of war themselves are all dependent upon grease lubrication.

Operating under the blessings of free enterprise and the spur of competition, our Industry has greatly increased its productive capacity. Technological progress, too, has played its part in preparing our Industry for the task ahead. No one can, of course, forecast with any degree of accuracy the demands which will be placed upon us. But, it is gratifying to know that we are, today, more than at any previous time, ready to meet any national emergency which may arise.

If the men and women of our Industry will realize that every task, no matter how menial it may seem at the time, plays a vital role in the over-all scheme of operation, we will always be able to meet tomorrow's demand. There is no such thing in the Petroleum Industry as an "unimportant job".



Kettle Room of a Modern Grease Plant

Bottom View of Kettles Used for the Manufacture of Greases

the story of a NEW GREASE

by GORDON S. BRIGHT

The Texas Company

For many decades in the past, lubrication presented no great problem. Motive power was furnished by air or water, by oxen or horses, or by man. Speeds in all cases were slow, bearings were crude, loose fitting, and uneven, no standard replacement parts were available, and machining methods were simple. Occasional applications of tallow or lard oil sufficed to maintain the slow pace of the pre-mechanized era.

With the advent of mechanical power, however, this situation changed. It is true that the change came gradually at first; but as machining methods were improved, parts became standardized, and tolerances less, crude methods of lubrication became increasingly inadequate. It became necessary, therefore, to change both the lubricants and the methods of application. During the early part of the current century and before, only a few greases were manufactured—and these greases were universally used in all types of equipment. Application was by hand at irregular intervals. More recently, because of the exacting demands of newer type equipment, it has been necessary to manufacture more specialized greases and to provide means for automatic lubrication. Today lubricants are tailor-made for many purposes and applied by fully automatic lubricating systems.

To most people, lubrication is a very minor problem. The mighty diesels which thunder across our nation, the planes that pass overhead, the automatic washers and other devices around the home are all accepted as the natural result of our progressing civilization. Few indeed know the mechanical principles involved in their operation and fewer still give any thought to their lubrication. The average citizen is concerned with lubrication only when the attendant at the corner service station checks the oil. But to the lubrication engineer, the maintenance personnel, the design engineer, and to those in lubricants research, the problem of overcoming friction to provide smooth operation and long life is an ever pressing problem. Every large oil company maintains a staff of experts who devote their whole talents to the quest for new and better lubricants.

The story of how a new grease comes into being is the story with which we are here concerned; and in many cases this story is fully as interesting as the story of the development of the equipment for which the specific grease is designed.

THE BEGINNING OF THE STORY

In many cases, the development of a new grease starts some time before the actual equipment to be lubricated is put in production. This will be increasingly true as design engineers grow in the consciousness that with specialized equipment lubrication cannot be ignored or left to chance. When the new equipment is still in the drawing board stage it may become quite apparent that some new set of conditions will be present which cannot be met by existing lubricants. These may involve high temperatures, extreme low temperatures, extreme water washing conditions, extreme pressures, or other conditions not normally encountered. At this point the grease technologist is called in, the requirements for the new grease are explained to him, and the development of a new product is begun.

ON THE NATURE OF GREASES

Greases are fundamentally thickened oils, and in the great majority of cases, are oils thickened with soaps of some type. They are not, however, simple mixtures. Rather, they are exceedingly complex physico-chemical systems the fundamental natures of which are still far from being well understood.

The ingredients which are used in the preparation of greases are of wide variety and impart widely differing characteristics to the finished product. The selection of ingredients is, therefore, a matter for very careful consideration. The ingredients used may be classified in numerous ways, but conveniently may be referred to as saponifiable materials—fats or fatty materials, bases—alkaline materials which may be reacted with fats to form soaps, oils—usually but not necessarily of petroleum origin, additives—special chemicals used to impart specific desired characteristics, and finally, miscellaneous materials including fillers, dyes, or other ingredients

not covered by the above classifications. Each of these classifications is very large in itself and each must be considered separately.

FATTY MATERIALS

Fatty materials may be grouped in a variety of ways but for the purposes of grease manufacture they may be classed as natural fats (glycerides), fatty acids, modified fats and fatty acids (as, for example, hydrogenated fats), fractionated fatty acids, and synthetic materials. Space will not permit an extended discussion of these groups, but a single example will serve to show the broad scope of each classification. Consider for a moment the natural fats.

Natural fats may be grouped broadly as animal fats, vegetable fats, and marine fats. Animal fats may be further subdivided to beef tallow, horse fat, hog fat, etc. Even these sub-groups, however, have widely varying characteristics. The average person might conclude for example that hog fat is hog fat and that the fat from one hog is like the fat from any other hog. The grease maker knows that this is not true. Physical and chemical characteristics of any given type of fat vary widely depending on the methods used in processing the fat, on the length of time the fat is stored, and on many other conditions. One factor which might not normally be considered is the geographic location in which the animal is raised. With hog fat, for example, a higher soap content must be used for a given penetration (hardness) when using fat from southern hogs than when using fat from northern hogs. This is due to the difference in the feeding habits of the hogs. Northern hogs are largely corn fed, whereas southern hogs feed on peanuts, cotton seed meal, and similar foodstuffs. The difference in feeding results in a difference in the degree of saturation of the fat (ratio of hydrogen to carbon in the fatty molecule), and hence, in the hardness or thickening powers of the soaps.

Differences such as those just discussed represent a relatively minor problem, since they can be determined by relatively simple laboratory tests and can be compensated for during manufacture of greases. The example is illustrative, however, of the many factors which must be taken into consideration when choosing a fatty material for the manufacture of a new grease. It can be readily visualized that if differences of this type are found in different lots of fat from the same species of animal, much greater differences are found between fats of different classification. In choosing the fatty material for a new grease, the source, method of preparation, average molecular weight and molecular weight distribution, degree of unsaturation of the fatty acids, the chemical nature of the unsaturated acids, and a number of other factors all must be considered. The fat chosen must contain enough saturated acids to give the desired soap to consistency ratio, yet in most cases should contain some unsaturated acids to give certain desired characteristics. But the unsaturated acids must be of such type as not to effect deleteriously the oxidation resistance of the finished product.

It should be quite evident at this point that the choice of a proper fatty material for the preparation of the soap is not a simple matter, nor can the choice be wisely made without a considerable background of experience and knowledge of the effects of various types of fatty materials on the characteristics of greases made from them.

TYPES OF SOAP

Just as there are many different types of fatty materials which may be used, so too, there are many different alkaline materials which may be used to form soaps. For grease manufacture, calcium, sodium, aluminum, and lithium soaps are most commonly used. For special purposes, however, or to impart special characteristics, soaps of barium, strontium, magnesium, lead, copper, other metals, and of organic bases may be used. All of the above may of course be used in various combinations and various ratios.

Calcium soap greases are among the most popular. These greases, often termed cup greases, are widely used industrially since they offer economical lubrication for line shafting, sliding surfaces of various types and lightly loaded anti-friction bearings operating at moderate speeds. Calcium soap greases are normally buttery in texture although they can be made stringy or tacky by proper choice of ingredients. Their outstanding characteristic is that they are highly water resistant and can be used successfully under extreme water conditions.

Calcium soap greases, made from usual materials and by normal methods of manufacture, cannot be successfully prepared without the incorporation of a stabilizer, i.e., a material added to prevent separation of the soap and oil. The stabilizer normally employed is water (about 1 to 4%). The presence of water, of course, imposes a temperature limitation on the usage of the grease, snice if used for an appreciable period above about 175° F., the water is lost by evaporation and separation of soap and oil occurs. As a result of work done in recent years, however, calcium soap greases have been developed in which high boiling point materials displace the water as stabilizers. These newer greases when properly made are heat stable and do not break down even when heated above their dropping points.

Sodium soap greases are also very widely used. These products, as contrasted with the buttery calcium soap greases, are normally fibrous in texture. For this reason, sodium soap greases exhibit much less tendency toward channeling than do calcium soap greases, since the grease is pulled by the gears or bearings into the path of the moving parts; on the other hand, the use of sodium soap greases results in higher running and starting torques. Sodium soap greases have less water resistance than calcium soap products but have much better high temperature characteristics, and give much better rust protection.

As might be expected, mixed sodium-calcium soap greases have properties intermediate between the two individual types with exact characteristics being dependent on the ratios of soaps used.

Aluminum soap greases have received some approval for a variety of uses, although they have never gained as general acceptance as the sodium and calcium soap greases. They are characterized by their smooth texture, transparency and water resistance, and are quite resistent to centrifugal action because of their cohesive nature. For this latter reason they have been used extensively for the lubrication of propeller hubs and for other similar applications.

Lithium soap greases have good water resistance, good high temperature characteristics, and a buttery to semi-buttery texture, but require special manufacturing procedures and high cost ingredients which prohibit their use in all applications where cost is a limiting factor.

A Mixed Base Grease During Manufacture

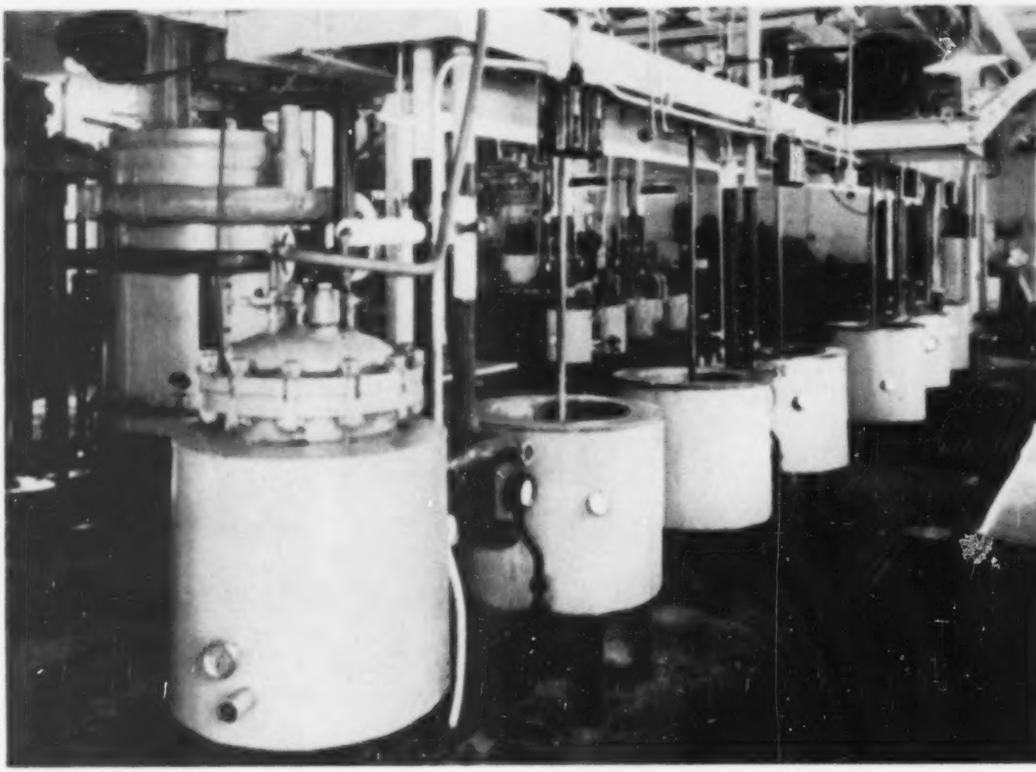
It is quite apparent at this point that a large number of different soaps are available through the use of the different types of fatty materials and by proper choice of one or a combination of the various materials which may be used for saponification of the fats. Usually several possible combinations appear promising for a new product, and the best must be selected on the basis of actual trial.

The choice of the type of soap to be used is of considerable importance since, as pointed out above, the type of soap has a considerable bearing on the characteristics of the finished product. Water resistance and rust resistance, for example, are closely related, since in most cases greases which are highly water resistant provide relatively low rust resistance or anti-rust properties. On the other hand certain other properties are determined largely by the type of oil used. This may be exemplified by the case of greases intended for low temperature operation. With the proper selection of oils a grease of good low temperature characteristics can be prepared with almost any of the common soaps; with improper selection of oils, good low temperature characteristics cannot be secured regardless of the type of soap used.

OILS

After a suitable type of soap (or several possibilities) has been chosen, attention must next be given to the mineral oil component of the new grease. In the modern refinery a wide variety of oils are available ranging from low viscosity distillate oils to very high viscosity residual oils, from oils of high paraffinicity to high naphthenicity, and from highly refined oils to oils with but little refining. In addition, to impart special characteristics, synthetic oils—oils prepared by the chemical ingenuity of man and which in some respects are superior to natural products—may be used.

No set rules can be formulated to govern the choice of the oil which should be used in the preparation of a new grease. In general, however, the choice is determined by the type of service for which the grease is intended. If the grease is to be used in bearings under heavy loads at relatively low speeds, high viscosity oils are used; with light loads and high speeds, low viscosity oils are used. If the grease is to be used in bearings which are infrequently lubricated and the grease must remain in service over long periods of time, highly refined paraffin oils of good oxidation resistance are used;



Grease Laboratory Kettles for Preparation of Experimental Products

if the bearings are relatively loose and the lubricant must be replenished at frequent intervals, less highly refined, lower cost oils may be employed. If the grease is intended for very low temperature use, the oil must be chosen on the basis of pour point and viscosity at low temperatures—flash point and volatility are matters of secondary concern; if, on the other hand, the grease is to be used under high temperature conditions, then flash point and volatility become of primary importance (to lessen fire hazard and to prevent excessive loss through vaporization) whereas pour point and other low temperature characteristics become secondary.

ADDITIVES

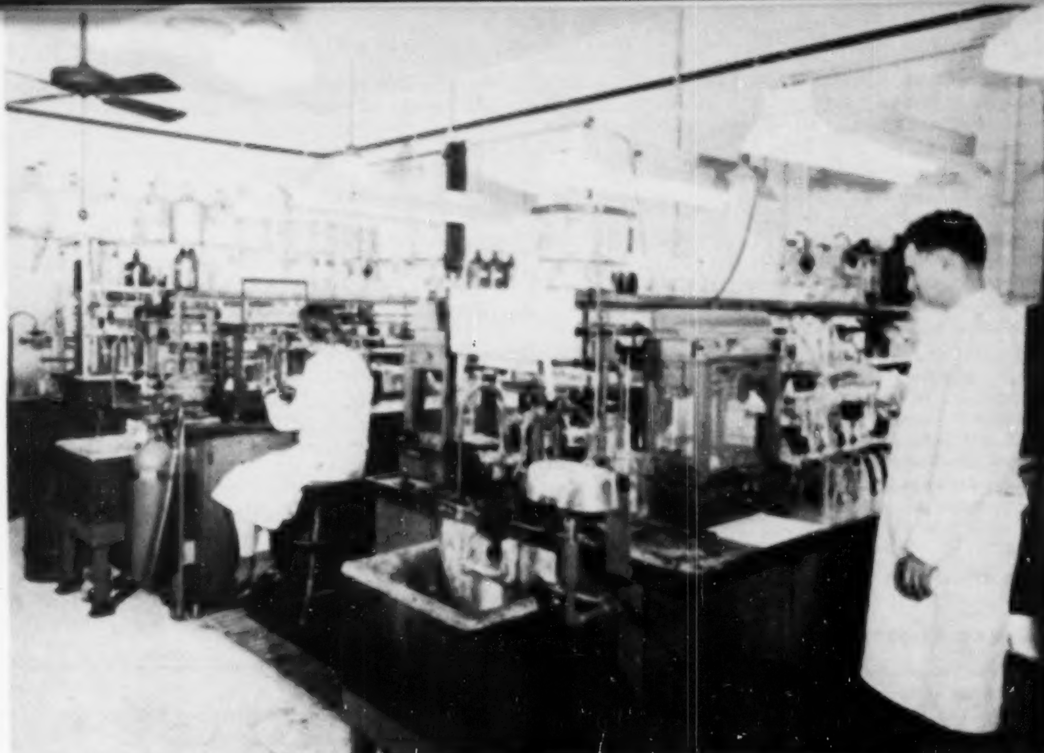
Although numerous variations in the character of greases may be brought about by variations in the basic ingredients (fats, saponifying agents, and oils), still another avenue of approach is open to the research chemist, i.e., through the use of modifiers or additives to achieve special characteristics. Not many years ago additives were but little known in grease manufacture; today, literally hundreds of materials are available and are in use. Additives may be incorporated to increase oxidation resistance, to impart extreme pressure characteristics, to improve water resistance ,to raise the dropping point, to increase tackiness, or for other purposes. In many cases, the amount of additive needed is very small, yet the effects produced may result in major changes in the over-all characteristics of the grease.

MISCELLANEOUS MATERIALS

The final group of materials used in grease manufacture is extremely heterogeneous, and includes such diverse materials as fillers (graphite, talc, metal dusts, etc.), dyes, and odorants. Fillers, although not used in most greases, do serve a very useful function in some cases, as for example when bearings are very rough or when external causes result in rapid loss of lubricant as in the case of extreme water washing or extreme high temperature conditions. Very careful consideration must be given, therefore, as to the advisability of using materials of this type and if so, which materials to select.

NUMBER OF POSSIBLE GREASES

A moment's consideration will show that the number of possible combinations of all the fats, bases, oils, additives, and miscellaneous materials is almost without limit. Aside from the possible combinations of known materials, however, cognizance must be taken of the applicability of materials not previously used. With the increase in demand for greases of new and unusual character, the grease maker must continually search for new materials to supply characteristics not



ABOVE . . . Close analytical control provides uniformity of production.
BELOW . . . Finished greases packaged in drums and ready for shipment.

available with the usual ingredients. This is, of course, a whole field of research in itself, but is, nevertheless, a factor which must be taken into consideration in the preparation of a new grease.

It is easily understood then, that even after a choice of materials has been made, a considerable amount of work remains to be done in the laboratory. For example, if the research chemist decides to use as a fat blend in one type-formula consisting of hydrogenated fish oil and tallow, he still cannot say without trial whether the best results will be secured with a 50-50, a 40-60, a 60-40 blend, or some other ratio. He may determine that an oxidation inhibitor will be required, but the best of several inhibitors and the optimum concentration of the best inhibitor must be determined. The manufacturing conditions must also be determined. There is no standard manufacturing procedure which will suffice for all types of grease. Sodium soap greases, for example, are normally fibrous in texture; but by using the same ingredients and varying the manufacturing procedure, greases which are fibrous with long fiber, fibrous with short fiber, ropy, semi-buttery, or buttery may be produced.

The next stage in the development therefore, involves research by trial.

LABORATORY RESEARCH

The modern grease research laboratory is a very interesting place. Here kettles may be found for the preparation of greases in quantities ranging from a pound or less up to several hundred pounds. A wide variety of mixing equipment, milling equipment and other apparatus used in modern grease making is available. Also available are many devices for the evaluation of greases. Testing equipment which gives a measure of the oxidation resistance, the extreme pressure characteristics, the pumpability under low temperature conditions, and other factors which must be considered in the particular application in question.

With the equipment the grease technologist makes a practical evaluation of the type formulations which are under consideration. In some few cases, only a small number of batches may be required; in other cases literally hundreds of trial batches may be needed. In any event after a few trials or many, a product is developed which, on the basis of laboratory evaluation tests, appears satisfactory for the intended use. A sufficient quantity of this product is then prepared to permit trial in actual operating equipment, for although laboratory tests are helpful, they do not always predict conditions which may be encountered in actual operation. This product is shipped, and in many cases the research chemist also journeys to the scene of the trial.

In some cases when the experimental product is subjected to actual service conditions it is found to be entirely satisfactory. In most cases, however, some shortcomings are found. These must then be overcome by further laboratory work. In any event, after one or several trials a satisfactory product is prepared. The new grease is then ready for full scale commercial production.

COMMERCIAL PRODUCTION

The conversion of a product from laboratory scale to full production must be carefully planned. The manufacture of a few pounds in the laboratory may be quite different from the preparation of 10,000 to 50,000 pounds per batch in full-scale commercial equipment. Plans must be made to deliver relatively large quantities of materials to the plant grease kettle at the proper time and in the proper proportion. In a few cases it may be necessary to design special equipment or to provide special storage facilities, new pumps or new lines. In most cases a mass of detail must be handled but most difficulties can be resolved on the basis of past experience. If plans are properly made, the product is successfully manufactured on the first trial. The product is tested, packaged, and shipped.

That is the story of a new grease up to the point at which it becomes listed as a regular product. It does not mean, however, that from this point on the product can be neglected. Through the years the service record of the product must be carefully followed. It must be modified and improved to meet changing conditions and to keep pace with the progress of the equipment which it is to lubricate. No one can tell how long the product will be manufactured. With the growing use of very high speeds, the introduction of new sources of power, the use of smaller and yet smaller tolerances for machined parts, and the use of new bearing materials it seems quite probable that the demand for new lubricants will grow and that many of the products now manufactured will no longer be useful.

"QUICK NOW! Are you taking ME to the N.L.G.I. Meeting—or aren't you?"

"The Linda Hall Library collection of 100,000 volumes in 4 years, however, is remarkable, being entirely scientific and technological literature, and constitutes a valuable asset to academic and industrial research."

TECHNICAL LIBRARIES *and the* Literature Search

by JOSEPH C. SHIPMAN

Linda Hall Library, Kansas City, Mo.

Since the first scientific journal, the Philosophical Transactions of the Royal Society of London appeared in March, 1665, it is estimated that some 50,000 journal titles have been published in the sciences. Broadly speaking, the Philosophical Transactions span the whole history of modern science, while many of the 50,000 other titles which followed in its train have had short lives, consisting of a few issues, or a few years publication. Nevertheless, the volume of such publication is staggering in extent, making it impossible for the scientist, engineer and technical man in 1950 to be acquainted with more than a tiny fraction of the literature of science. In an age of extreme specialization this would not seem to present too serious a problem. Actually it becomes a library problem, and more specifically a bibliographic problem which is solved by the collective contribution made by scientific societies, professional, engineering and technical organizations throughout the world in the production of abstracts, annual indexes and systematic surveys of the literature. Just as no individual could perform this immense task himself, no individual could afford to collect, organize and house the results of these world-wide cooperative enterprises. Still less could an individual afford to subscribe to, or ever find time to read more than a small part of the total number of periodicals which could conceivably carry information of interest to a specialist or a research worker. Indeed, the ordinary public or university library with relatively ample funds, adequate storage capacity and a large staff, finds it extremely difficult to cope with the flood of printed material which threatens to engulf it.

The importance of the technical library has become in many cases secondary only to the laboratory or the workshop, and in the constant effort to avoid duplication of expensive work, has become a port of first call in the initiation of many new investigations and enterprises. A technical worker can rarely operate without books, and seldom without access to libraries where there are large collections of books, journals,

and other materials in his area of special interest. Though there are almost 12,000 libraries throughout the United States (without counting the many small collections in special libraries) there are a limited number of institutions which have collections of scientific and technical materials large enough and broad enough in coverage to meet the needs of the specialist.

Brief mention might be made here of some outstanding technical libraries. The Library of Congress, with more than eight million volumes, has of course a rich reservoir of scientific and technical material, though it is not primarily a technical library. The Engineering Societies Library in New York, and the Chemists' Club in the same city have outstanding collections and render noteworthy service to their patrons. The U. S. Department of Agriculture Library in Washington, in spite of the logical emphasis on agriculture which is to be expected, has a broad and rich collection of printed materials in all fields of science and engineering. The Surgeon General's Library, like the Department of Agriculture Library, is especially concerned with one subject field—in this case medicine, and surgery,—but also has very considerable holdings in many related fields, particularly in the biological and chemical sciences.

Among the larger privately-endowed non-academic libraries, the foremost is the John Crerar Library of Chicago, founded in 1894, specializing in the literature of Science, Business Technology, and the Medical Sciences with a collection of more than three quarters of a million volumes.

The Linda Hall Library, established in Kansas City in 1946, is a Science and Technology Library, also privately endowed, but dedicated to serving the people of Kansas City, and the surrounding areas of the Midwest. Its collection now numbers more than 100,000 volumes, and it receives currently more than 2,800 journals from all over the world. Its journal holdings, old and new, amount to more than 8,000 separate titles, making it possible for technical men and scientists in the region to find a large portion of the materials which they are likely to need in making a library search.

Many large public libraries throughout the country have excellent facilities for scientific and technical library work, and some of them possess very rich and important collections. The New York Public Library, the Cleveland Public Library, the Detroit Public Library, the Enoch Pratt Free Library in Baltimore, and the Carnegie Library of Pittsburg are outstanding examples.

Some of the great University libraries rank at the top of the list in book resources, and in facilities for research. Harvard's great library is second only to the Library of Congress, and institutions such as Columbia, University of Illinois, University of Michigan and the University of Minnesota are not far behind. The emphasis from library to library will vary to some extent and some subject areas will receive better coverage, or lesser attention in this library or that.

Using the latest available data in "Special Libraries Resources", which are up to nine years old in some cases, the sizes of the libraries mentioned are:

S. L. R. Number	Library Name	Size, Volumes	Year of Inventory
157	Library of Congress	6,253,800	1941
1914	Engineering Societies	160,000	1947
1782	N. Y. Chemists Club	60,000	1947
180	U. S. Dept. Agriculture	300,000	1941
226	Surgeon General's	418,000	1941
1021	Surgeon General's	ca 1 million	1946
264	John Crerar	621,379	1941
	Linda Hall*	"100,000"	1949
544	New York Public	2,758,062	1941
610	Cleveland Public	2,197,663	1941
399	Detroit Public	1,012,328	1941
317	Enoch Pratt Free Lib.	740,752	1941
700	Carnegie, Pittsburgh	1,064,000	1941
1397	Harvard	2,075,000	1946
	Do	4,968,316	1947

*Not listed in "Special Library Resources".

Some of the above inventory figures included pamphlets and some were books only, also some of the libraries have mostly scientific material, others mostly fictional, or non-scientific, so that comparisons are not very conclusive. The Linda Hall library collection of 100,000 volumes in 4 years, however, is remarkable, being entirely scientific and technological literature, and constitutes a valuable asset to academic and industrial research.

Taking acadamic libraries, which also vary in their proportion of pamphlet and non-scientific material, the following constitute the class over 1 million, based on 1947 data:

Library	Size, Volumes
Harvary University	4,968,316
Yale University	3,642,730
University of Illinois	2,076,312
Columbia University	1,836,590
University of Chicago	1,654,747
University of Minnesota	1,474,580
University of California, Berkeley	1,422,494
University of Michigan	1,309,720
Cornell University	1,299,798
University of Pennsylvania	1,132,465
Princeton University	1,086,280

The half million to million class were:

Northwestern University	851,771
University of Texas	832,786
Johns Hopkins University	760,271
New York University	748,219
Ohio State University	733,263
University of Colorado	655,593
Indiana University	615,243
University of Cincinnati	606,452
Western Reserve University	604,000
State College of Washington	592,930
State University of Iowa	589,114
University of Missouri	547,505
Univ. of California, Los Angeles	536,974
Univ. of North Carolina	494,467

The schools which tend to emphasize technological studies have generally smaller libraries than universities which have a greater proportion of arts work.

Massachusetts Inst. of Tech.	405,424
University of Kansas	382,120
Iowa State A. & M.	376,946
Pennsylvania State College	280,237
Purdue University	237,920
Rice Institute	183,950

Kansas State	147,080
Texas A. & M.	130,651
U. S. Military Academy	128,562
Colorado A. & M.	121,963
Virginia Polytechnic Institute	118,853
Alabama Polytechnic Inst.	116,927
Illinois Institute of Technology	114,846
U. S. Naval Academy	109,014
Drexel Inst. of Tech.	91,722
Georgia Inst. of Tech.	84,868
Texas Technological	65,592
California Inst. of Tech.	65,419
Carnegie Inst. of Tech.	55,666
Louisiana Polytechnic	38,127
Stevens Inst. of Tech.	32,000
Case Inst. of Tech.	23,051

To the research man or the technical man working in a location far distant from any of these centers, this account may sound somewhat meaningless. Yet it should not be so. In the growth of American libraries perhaps one of the most significant features has been the interest in close and effective cooperation between libraries. This cooperation has taken the form of ready and willing interlibrary loan of such materials as can be spared and which will not suffer from the rigors of transportation from one institution to the next. It has also played a part in the publication, sponsorship, and operation of various Union catalogs and Union lists of serials which permit a librarian to know where special book and journal materials may be found when they are not to be had in his own institution. Most research workers will be located at a point not far from some library which has in its collection the great catalog of the Library of Congress Printed Cards, and there will be few libraries no matter how small which will not possess the "Union List of Serials" which lists the holdings library by library, of practically all journal titles to be found anywhere in the United States or Canada.

Even if the material needed is too rare, too expensive or too important for loan, most libraries today have photostat or microfilm facilities, which make it possible for a modest cost to secure copies of such materials. Members of the American Chemical Society, may obtain copies of any article which has been abstracted in "Chemical Abstracts" (abstracting more than 4,200 journals) at a cost which amounts to $1.10 for a microfilm copy (regardless of the length of the article) or $1.10 for a photoprint of any article up to 5 pages in length. For this service, limited to American Chemical Society members, special books of coupons must be obtained from the Secretary of the Society, or from the Editor of "Chemical Abstracts". The charges will be higher when microfilm or photostats are ordered from other libraries because of the difference in facilities and in the volume of work handled. However in all cases, it is cheaper than an expensive trip to a distant library where a number of needed references may be consulted.

In some cases the scientific or technical worker will be more concerned about how to locate the information in the literature than he will be in the matter of obtaining the actual journal or book. In that connection Byron A. Soule in his "Library Guide for the Chemist" gives the following outline for making a library search:

I Preliminary survey
  A. Encyclopedias
  B. Monographs
  C. Textbook
II Comprehensive treatises
III Annual reviews
IV Bibliographies of bibliographies
V Abstract journals
  A. Cumulative indexes
  B. Annual indexes
  C. Current issues
VI Original articles
  A. Journal articles directly cited
  B. Patents directly cited
  C. Journals specializing in the subject.
  D. Investigators specializing in the field
VII Laboratory guides
VIII General browsing

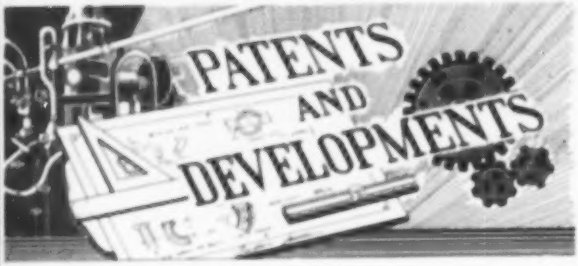
As will be seen from an examination of Heading Numbers I to IV, the search usually begins with books, for reasons which are fairly obvious. They summarize the literature, and they are more economical in time and money than journals. Their chief disadvantage, of course, is that their information is less likely to be up to the minute. In order to use the books in a library, the first consideration is the ability to use the card catalog. It is useful to know, when a book is not found in the library catalog, that there are books such as the "United States Catalog" and the "Cumulative Book Index" which will permit you to find the author, title, date of publication and price of all books in the English language. Again it is important to remember that tools such as these are to be found in all libraries except the smallest. In larger libraries there are other national trade bibliographies which will do similar service for foreign books.

To the beginner in a literature search, a general reference guide such as Mudge's "Guide to Reference Books" may be of great help. In Chemistry, there are three or four excellent guides to the literature—Crane's "Guide to the Literature of Chemistry", Mellon's "Chemical Publications and their use", Soule's "Library Guide for the Chemist". In mathematics and physics there is Parke's "Guide to the Literature of Mathematics and Physics including related works on engineering science". Engineering has several guides, the only American one being the recent Dalton's "Sources of Engineering Information." These books are excellent introductions to the literature which they cover, and give the bird's-eye view which is so important in deciding how to tackle a literature problem.

Reference work in special fields consist of dictionaries, encyclopedias, handbooks, texts, treatises and monographs, which are all useful for obtaining factual information. They can be used to limit the problem on the one hand, or to obtain a broad survey on the other. General bibliographies are useful tools which if recent enough, or pertinent enough, may present a virtually complete picture of the literature. Look for them in the library catalog.

In making a periodical search, it is obviously necessary to make use of abstracting and indexing services. Crane and Patterson in the "Guide to the Literature of Chemistry" give a thorough discussion of this topic. Though they emphasize chemistry, their treatment is broad enough to suit many other applications.

(Continued on page 20)



STABLE LIME BASE GREASES—A recent patent issued to Socony-Vacuum Oil Co. discloses production of lime base greases of improved stability under conditions of storage and use, particularly as an improvement over the greases described in U. S. patent 2,197,263. One improvement is in minimizing skin hardening, i.e., hardening of the surface of the grease when exposed to combinations of moderate temperatures and high humidity. Another improvement is with reference to the Sett test.

Improvement is effected by replacing a portion of the short chain fatty acid modifier by phosphoric acid. An example of a composition prepared according to the patent is as follows:

	Percent (Weight)
Tallow	13.45
Candelilla wax	4.00
Lime flour	5.25
Glycerine	2.00
Acetic acid	3.20
Phosphoric acid	0.80
Solar Red oil	71.30

While the exact reaction into which the phosphoric acid enters has not been studied, it is believed that calcium phosphate or a calcium compound of a partial ester of phosphoric acid is produced (U.S. 2,513,680).

OXIDATION AND DISCOLORATION-RESISTANT LIGHT COLORED GREASES—Light colored lubricating greases having effective resistance to oxidation and to metal activation and free from discoloration have been produced by Standard Oil Development Co. by use of a combination of a relatively very small amount of phenyl beta-naphthylamine together with a relatively larger amount of a condensation product of di-isobutyl phenol with formaldehyde and ammonia, which may be called di-isobutyl phenol methyl amine, already disclosed in U. S. patent 2,340,036, the combination being used in a slightly alkaline grease. This mixture is effective also in preventing discoloration of copper and appears to be an effective anti-oxidant in the presence of a copper catalyst. Apparently the condensation product has a synergistic effect on the anti- oxidant properties of phenyl beta-naphthylamine since the condensation product itself is relatively ineffective as an anti-oxidant.

One example given is a lubricating grease having a pH of at least 7.0 and consisting mainly of a liquid oily lubricant thickened to a grease-like consistency with about 22-33% by weight, based on the total composition, of a metal soap of aliphatic fatty material, 2-15% of a resinous oil-soluble condensate product of di-isobutyl phenol and hexamethylene tetramine and .02-.5% of phenyl beta-naphthylamine.

The invention is claimed to be particularly applicable to greases of high soap content, especially those containing about 22-30% by weight of soap, especially rapeseed oil soaps causing skin irritations. Such irritations are claimed to be minimized by the inhibitor described (U.S. 2,515,133).

CONTINUOUS PRODUCTION OF STABLE BASE GREASES—Rapid and continuous or semi-continuous production of aluminum soap-thickened lubricating grease having high stability, good texture and firm consistency is discussed in a Standard Oil Development Co. patent. According to the invention disclosed, it has been found that by the proper choice and blending of appropriate types of mineral lubricating oil, at least one of which contains, as a mineral ingredient, a polar compound or group of compounds effective as suitable crystallization modifiers, a good aluminum soap grease may be prepared. A lubricating oil distillate which, without finishing, contains active crystallization modifying material, such as alkylated phenols, phenolic derivatives, naphthenic acids, etc., is commonly obtained in the simple distillation of Venezuelan or Coastal type crude oils. The quantity of such modifiers is generally about 1-1.5% by weight in the lubricating oil distillate. This is more than is needed to modify the soap crystallization in the rapid or close-clearance cooling process, and greases prepared solely with this oil have very poor structures. Hence, it is necessary to dilute the untreated oil with a sufficient amount of refined or neutral oil which has been treated with clay, etc. to reduce the free acid and phenolic content to very low values. The two oils are blended to obtain a stock having a modifier content of 0.1-1%, preferably .25-.75% by weight of the finished grease. These naturally-occurring modifiers are effective to a very satisfactory degree for modifying the crystallization of aluminum soaps. Figure 1 discloses a flow diagram to illustrate the steps in the process. The Venezuelan or other naphthenic crude is subject to vacuum dis-

(Continued from page 19)

In chemistry there is the great "Chemical Abstracts", with its decennial indexes, as well as the "British Chemical Abstracts" and the "Chemisches Zentralblatt". In engineering, there is the annually cumulated "Engineering Index" and "Industrial Arts Index". In physics and electronics there is "Science Abstracts". In biological sciences, "Biological Abstracts" and the Zoological Record" are outstanding. Medicine has its "Quarterly Cumulative Index Medicus", agriculture its "Agricultural Index" and "Bibliography of Agricilture". Mathematics its "Mathematical Reviews" etc. The literature of astronomy, of geology, of metallurgy and many other special fields have comparable, if not equal abstracting and indexing publications which may be consulted.

The literature of science and technology, while truly enormous, has perhaps the best planned and organized tools for digging and mining it, that can be claimed by any branch of human knowledge. Many medium sized libraries will have these tools on hand, and with the larger institutions, possessing immense resources, standing by to give assistance, by way of interlibrary loan, microfilm and photostat, there is little reason why a literature search cannot be effectively handled in most localities.

tillation to separate the lighter fuel distillate and heavier asphalt and the intermediate lubricating oil distillate is separated into two streams so that part of it goes to the grease cooking unit while another part is subjected to normal finishing operations. The finished neutral stock is then taken to the cooker where it is blended, in suitable proportions (based on the desired modifier content), with the unfinished distillate as well as the aluminum stearate or other aluminum soap which is preferably an aluminum soap of fatty acids of 12 to 22 carbon atoms such as hydrogenated fish oil acids. Saturated fatty acids are preferred because of their superior oxidation stability. The proportion of finished and unfinished oils usually runs about 1 to 4 parts by weight of finished or neutral stock combined with 10 to 2 parts by weight of raw or unfinished oil. The aluminum soap content is about 5-15% of the weight of the finished grease. As the ingredients are mixed, they are heated to at least 250°F but not as high as 350°F and for a short while. The heated mixture is then passed in continuous flow through the rapid cooler and then packaged. A preferred aluminum base grease of smooth texture, made according to this invention, contains about 62% of unfinished Venezuelan distillate containing about 1-1.5% polar compounds with 32% of finished Coastal oil as a diluent and 6% of aluminum soap of saturated fatty acids having 12 to 22 carbon atoms (U.S. 2,514,311).

Figure 1

SELF-THICKENING LUBRICATING GREASE COMPOSITION—A grease which normally may be liquid, or at least semi-fluid, but which sets up to a solid grease structure having a definite penetration resistance upon working, is described in a Standard Oil Development Co. patent. The preferred grease consists essentially of mineral lubricating oil containing approximately normal grease-forming proportions of the sodium, potassium, or mixed sodium and potassium soaps and salts of a mixture of low and high molecular weight carboxylic acids, saturated or unsaturated. It appears that a fairly stable super-saturated solution of soap in oil is obtained by finely dispersing the soap and salts. Such a composition remains quite fluid until the composition is subjected to mechanical working. The composition preferably contains acrylic acid as the low molecular weight fatty acid, while the higher fatty acid may comprise those preferably having 14 to 22 carbon atoms. Also, the quantity of soaps is not less than about 8% and not more than 30% by weight, based on the total composition.

A preferred grease composition contains the following ingredients:

	Per cent
Hydrogenated fatty acids from fish oil acids of molecular weight of C_{18} and above (substantially saturated, iodine No. about 4 or 5)	10
Acrylic acid	1
Sodium hydroxide	2.5
Phenyl alpha naphthylamine	0.5
Mineral oil of 500 sec./100° F.S.S.U. viscosity obtained from selected Low Cold Test crudes	86.0

The hydrogenated fatty acids and 1/3 of the mineral oil are first charged to a fire-heated grease kettle and warmed to about 150° F. The acrylic acid is then added and the mixture is stirred and caustic, in aqueous solution, is added with stirring, the temperature being raised to 210° F. The resulting heavy soap mass is dried, all the water being substantially evaporated. The remainder of the mineral oil is then added in small portions while heating is continued. The temperature is gradually raised to at least 500° F and held at that point until foaming subsides and the soap has melted and become completely dispersed or dissolved in the mineral oil. Then, heating is discontinued and the grease is cooled in the kettle to 200° F with stirring. Upon reaching that temperature, stirring is discontinued and the composition is thereafter allowed to cool to ambient temperature, thus giving a smooth, homogeneous fluid or semi-fluid mass which could be poured readily into containers. An anti-oxidant such as phenyl alpha naphthylamine may be added (U.S. 2,514,286).

UNI-TEMP GREASE—Texas Co. reports that its Texaco Uni-Temp grease—the first product marketed to meet A-N requirements for low temperature aircraft lubricating grease, has been improved and now also meets requirements for U. S. Army instrument lubricating users (Oil & Gas J. 6/22/50 p. 342).

UREA ADDUCT FORMATION—*Zimmerschied et al* disclosed formation of urea adducts of straight chain hydrocarbons. These may have possibilities in the grease field (Petroleum Engr. Refinery Annual, 1950 p. C43) (Technical Survey, 1950 p. 358).

N. L. G. I. Annual Meeting

"I wanna attend the N.L.G.I. Annual Meeting so bad I can just taste it!"

1950 - FUTURE MEETINGS OF YOUR INDUSTRY

SEPTEMBER

3-8 American Chemical Society Chicago, Ill.

5-9 Sixth National Chemical Exposition, Coliseum, Chicago, Ill.

8-9 Michigan Petroleum Assn., (fall convention), Grand Hotel, Mackinac Island, Michigan.

10-13 American Inst. of Chemical Engineers (regional meeting), Radisson Hotel, Minneapolis, Minn.

11-13 Oil Industry Information committee, Traymore Hotel, Atlantic City, N. J.

SEPTEMBER (cont.)

11-15 American Socy. of Mechanical Engineers and Instrument Socy. of America (Industrial instruments and regulators conference), Municipal Auditorium, Buffalo, N. Y.

12-14 Socy. of Automotive Engineers, (tractor meeting), Hotel Schroeder Milwaukee, Wis.

13-15 National Assn. of Motor Bus Operators (21st annual meeting), Drake Hotel, Chicago, Ill.

13-15 National Petroleum Assn., Hotel Traymore, Atlantic City, N. J.

SEPTEMBER (cont.)

14 American Petroleum Institute, (Lubrication Committee), Hotel Traymore, Atlantic City, N. J.

18-22 Fifth National Instrument Conference and Exhibit, Memorial Auditorium, Buffalo, N. Y.

19-23 American Socy. of Mechanical Engineers
Hotel Sheraton, Worchester, Mass.

20-21 Ohio Petroleum Marketers Assn., (fall conference), Netherland Plaza Hotel, Cincinnati, Ohio

25-27 American Socy. of Mechanical Engineers (Petroleum Mechanical Engineering division)
The Roosevelt, New Orleans, La.

25-27 American Trade Assn. Executives
Somerset Hotel, Boston, Mass.

26-29 Iron and Steel Exposition and annual Convention of Iron and Steel Engineers, Cleveland Public Auditorium, Cleveland, Ohio

27-29 National Metal Trades Assn.
Hotel Commodore, New York, N. Y.

27-30 Socy. of Automotive Engineers (aeronautic meeting and aircraft engineering display)
Biltmore Hotel, Los Angeles, Calif.

OCTOBER

1-3 Independent Petroleum Assn. of America (annual meeting)
Jefferson Hotel, St. Louis, Mo.

3-5 American Inst. of Electrical Engineers (district No. 2), Lord Baltimore Hotel, Baltimore, Md.

11 American Iron and Steel Inst. (regional technical meeting), Hotel William Penn., Pittsburg, Pa.

12-13 Indiana Independent Petroleum Assn. (fall convention)
Hotel Severin, Indianapolis, Ind.

16-18 Socy. of Automotive Engineers (transportation meeting)
Hotel Statler, New York, N. Y.

OCTOBER 30, 31 AND NOVEMBER 1
EDGEWATER BEACH HOTEL, CHICAGO, ILLINOIS

OCTOBER (cont.)

16-20 National Safety Congress Chicago, Ill.

16-21 Oil Progress Week

19-22 Permian Basin Oil Show, Odessa, Texas

20-21 American Management Assn., Hotel Statler, New York, N. Y.

23-27 American Inst. of Electrical Engineers (fall general meeting), Skirvin Hotel, Oklahoma City, Okla.

23-27 National Metal Exposition Amphitheatre, Chicago, Ill.

24-25 South Dakota Independent Oil Men's Assn.
Aberdeen Civic Arena, Aberdeen, S. D.

25 American Iron and Steel Inst. (regional technical meeting), Hotel Thomas Jefferson, Birmingham, Ala.

30 to Nov. 1 NATIONAL LUBRICATING GREASE INSTITUTE (annual meeting),
Edgewater Beach Hotel, Chicago, Ill.

31 Oil Trades Assn. of New York, Waldorf-Astoria Hotel, New York, N. Y.

NOVEMBER

2-3 Socy. of Automotive Engineers (diesel engine meeting)
Hotel Knickerbocker, Chicago, Ill.

3-4 Socy. of Rheology (annual meeting)
Hotel New Yorker, New York, N. Y.

9-10 Socy. of Automotive Engineers (fuels and lubricants meeting)
Mayo Hotel, Tulsa, Okla.

10 American Iron and Steel Inst. (regional technical meeting), Hotel Mark Hopkins, San Francisco, Calif.

11-13 OIL INDUSTRY INFORMATION COMMITTEE
Biltmore Hotel, Los Angeles, Calif.

NOVEMBER (cont.)

13-14 AMERICAN PETROLEUM INSTITUTE (Lubrication Committee), Biltmore Hotel, Los Angeles, Calif.

13-16 AMERICAN PETROLEUM INSTITUTE (30th annual meeting) Biltmore Hotel and the Ambassador, Los Angeles, Calif.

13-17 Nat'l. Electrical Manufacturers Assn., Chalfonte-Haddon Hall, Atlantic City, N. J.

26 to Dec. 1 American Socy. of Mechanical Engineers
Hotel Statler, New York, N. Y.

27-29 American Standards Assn. Waldorf-Astoria Hotel, New York, N. Y.

27 to Dec. 2 19th Exposition of Power and Mechanical Engineering
Grand Central Palace, New York, N. Y.

DECEMBER

3-6 American Inst. of Chemical Engineers (annual meeting), Neal House, Columbus, Ohio

4-5 Oil Industry TBA Group (1950 meeting), Edgewater Beach Hotel, Chicago, Ill.

26-31 American Assn. for the Advancement of Science (annual meeting) Hotel Statler, Cleveland, Ohio

1951—Future Meetings Of Your Industry

JANUARY, 1951

8-9 Kansas Oil Men's Assn. (Annual Convention), Lassen Hotel, Wichita

8-12 Socy. of Automotive Engineers (annual meeting and Engineering display)
Hotel Book-Cadillac, Detroit, Mich.

22-26 American Inst. of Electrical Engineers (winter general meeting), Hotel Statler, New York, N. Y.

25-26 Northwest Petroleum Assn. (annual convention), Nicollet Hotel, Minneapolis, Miss.

FEBRUARY, 1951

20-21 Kentucky Petroleum Marketers Assn. (annual meeting, convention, and trade show), Brown Hotel, Louisville, Ky.

27-28 Wisconsin Petroleum Assn. (annual convention and equipment show), Milwaukee Auditorium, Milwaukee, Wisc.

MARCH, 1951

5-7 Manufacturers Standardization Socy. of the Valve & Fittings Industry (annual meeting), Commodore Hotel, New York, N. Y.

6-8 Socy. of Automotive Engineers (passenger car, body, and materials meeting), Hotel Book-Cadillac, Detroit, Mich.

7-9 AMERICAN PETROLEUM INSTITUTE (Division of Production, Southwestern district meeting), Hotel Beaumont, Beaumont, Texas

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"The annual meeting is going to hit me just right . . . Ooops!

GREASONALITIES

SPOKESMAN SUCCESS . . . in September 1949, our official publication won an Improvement Award, and this May we won another award "In recognition of exceptional accomplishment in achievement of purpose, excellence of editorial content and effectiveness of design," from the International Council of Industrial Editors. Such a performance, particularly for a technical publication, doesn't fall far short of being downright remarkable, and all N.L.G.I. members have a right to be proud of this record.

HAROLD FRASER

Who is responsible for this success? Primarily two men: Harold M. Fraser, chairman of the editorial committee to procure technical articles, and Gus Kaufman, past chairman of an editorial subcommittee consisting of four members who have reviewed and passed upon all material submitted for publication for authenticity and determination of the type of material for publication. This committee membership has been secret, and it is now possible to tell you the name of the past chairman because he recently resigned, passing over his work to another chairman of the committee. This is in accordancee with instructions from the N.L.G.I. Board of Directors who established the committee to operate for a single year, with all except one member, resigning at the end of that year. Wish we could tell you the names of the members of the new committee, but we feel certain they will equal the outstanding job performed by their predecessors.

Harold Fraser and his committee consisting of Mr. C. J. Boner, Battenfeld Grease and Oil Corp.; Mr. L. W. McLennan, Union Oil Co. of California; Mr. E. S. Glauch, Joseph Dixon Crucible Co.; Mr. M. Ehrlich, American Lubricants; and Mr. M. Finlayson, Mellon Institute of Industrial Research; has consistently sought out new and fresh material suitable for SPOKESMAN readers. More power to them.

GUS KAUFMAN

We greatly regret to see Gus Kaufman resigning from the pivotal chairmanship he has held. He has contributed so much to the Current SPOKESMAN success, not only in the lubricating grease industry, but also in the editorial field.

MR. O. L. YARHAM . . . is a recent addition to the technical staff of the Cities Service Oil Company's laboratories at East Chicago, Indiana. His special assignment will be the pursuit of practical research and development work on lubricating greases.

O. L. YARHAM

Mr. Yarham received a B.S. degree in Chemical Engineering from the University of Kansas in 1940. After graduation he engaged in diversified work with the U. S. Army Engineers, Joseph E. Seagram & Sons, Inc., and the U. S. Department of Agriculture. During the past six years, however, he has worked as a chemical engineer and grease research chemist for the Battenfeld Greases and Oil Corporation.

Mr. Yarham, his wife and two daughters, are now residing in Park Forest, a new suburb southwest of the city of Chicago.

THIS MONTH YOU ARE GOING TO MISS . . . the Technical Committee column written by T. G. Roehner, chairman of our Technical Committee. Ted is enjoying a well-deserved vacation. He will have his usual column in the October issue of the SPOKESMAN. Where he is vacationing and what doing he has declined to say, which probably is just as well. We can authoritatively say that the false rumors to the effect that he has taken up figure skating or entered a 6-day bicycle race during his vacation are completely unfounded. He probably has done nothing more exciting than gaze thoughtfully at a test tube or pipette.

ANNOUNCEMENT . . . has been made that the N.L.G.I. September Board of Directors meeting will be held at the Hotel Traynor, Atlantic City, New Jersey, Thursday, September 14, at 9:30 a.m.

RALPH MATTHEWS . . . retired vice president of Battenfeld Grease and Oil Company, writes that he and Mrs. Matthews have enjoyed a trip through Minnesota, North Dakota, Montana, and are now visiting relatives in the Willamette Valley of Oregon. While in Minneapolis, Minnesota, they visited Ray Timberlake, manager of Battenfeld's Minneapolis branch, who had been ill at that time.

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Titre	63° to 65° C
Free Fatty Acid	2.0% maximum
Acid Number	4.0 maximum
Iodine Number	6.0 maximum
Saponification Number	190 to 195
Specific Gravity @ 100/25° C	0.850

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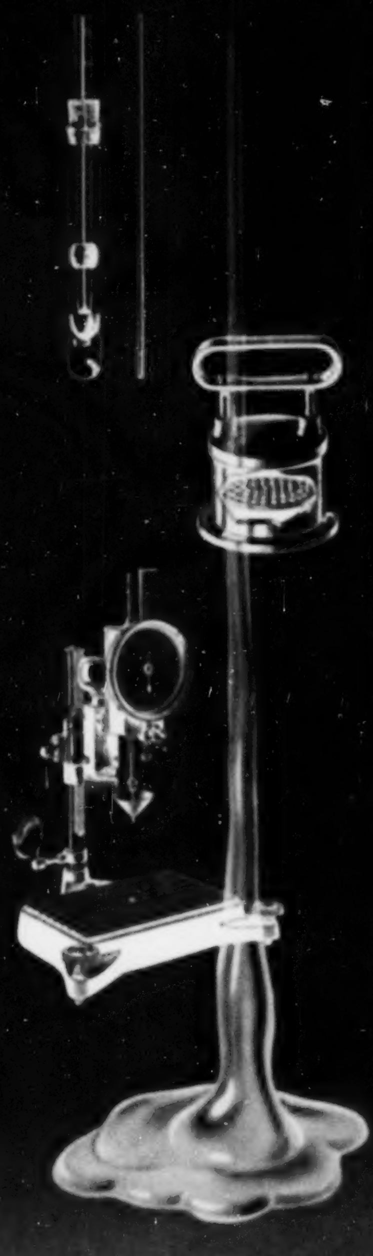

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Color 5¼" Lovibond Column (max.)	35 Yellow—8 Red		
Iodine Value (Wijs)	25	—	35
Free Fatty Acid (as oleic)	100	—	104%
Acid Number	199	—	206
Saponification Value	202	—	209

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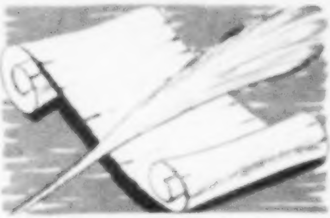

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Division of the Sun Chemical Corporation
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The Werner G. Smith Co.
(Division of Archer-Daniels-Midland Co.)
2191 West 110th Street
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Member—F. C. Haas

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Member—Henry Frazin

Continental Can Co.
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Geuder, Paeschke & Frey Co.
324 North Fifteenth Street
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Member—Willard J. Flint

Inland Steel Container Company
6532 South Menard Avenue
Chicago 38, Illinois
Member—G. D. Zurk

J & L Steel Barrel Company
405 Lexington Ave.
New York 17, New York
Member—Jerry Lyons

National Steel Container Corporation
6700 South LeClaire Avenue
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917 Roanoke Ave. So. E.
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570 Lexington Avenue
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Member—G. Wesley Gates

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30 Rockefeller Plaza
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Midwest Research Institute
4049 Pennsylvania
Kansas City 2, Missouri